

NS 102

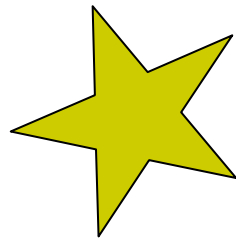
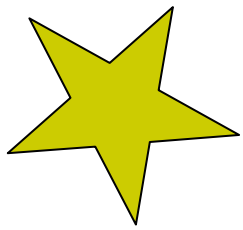
Lecture 4

April 8, 2004

Gnat Sigh News

<http://home.fnal.gov/~rocky/natsci102/>

- Revised Syllabus (April 15th exists exam April 22)
- *Survivor, Greece* action script and action photos
- Lab write-up
- Script for class reading of Galileo Dialogue



**Rocky Kolb-GnatSigh
Productions
Presents**

**UNRATED!!!!!!
contains cosmologically
explicit material**

***The Dialogue Concerning the
Two Chief World Systems***



April 13, 2004



**Salviati: Alissa Cambronne
Simplicio: Evelyn Rosas
Sagredo: Emily Boyd**



Barbara Muehleck Kepler:

“... simple of mind and fat of body, with a stupid, sulking, lonely, melancholy disposition.”

...that man has in every way a dog-like nature.

... his appearance is that of a little lapdog.

... his appetites are like a dog; he likes gnawing on bones and dry crusts of bread.

... like a dog he drinks little and is content with the simplest foods.

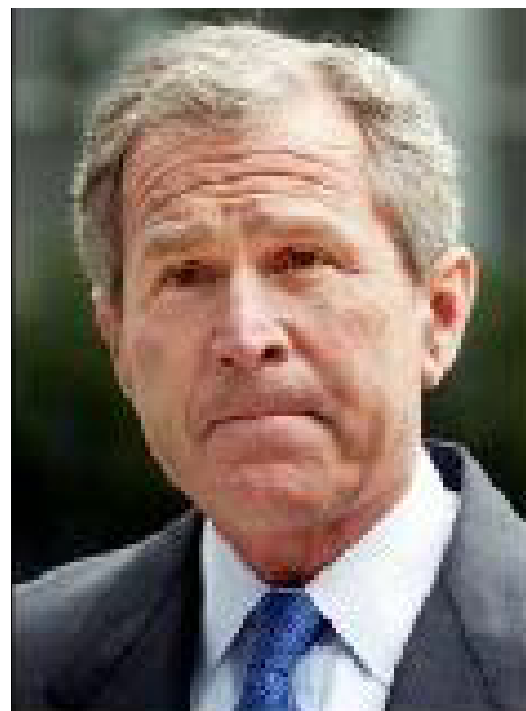
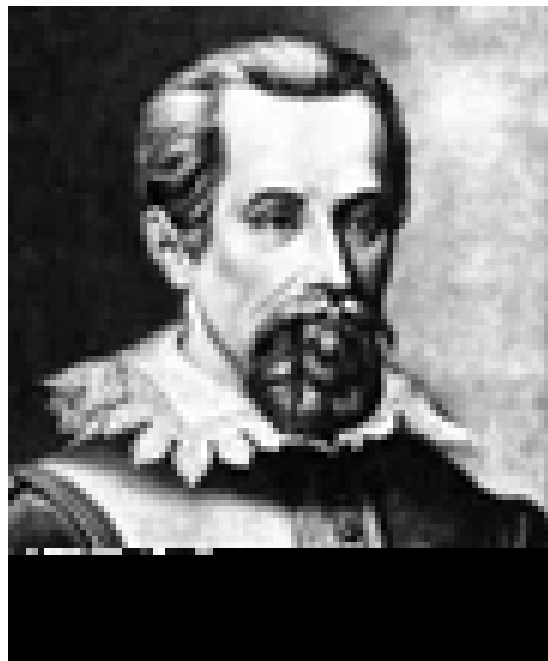
... he happily greets visitors like a dog.

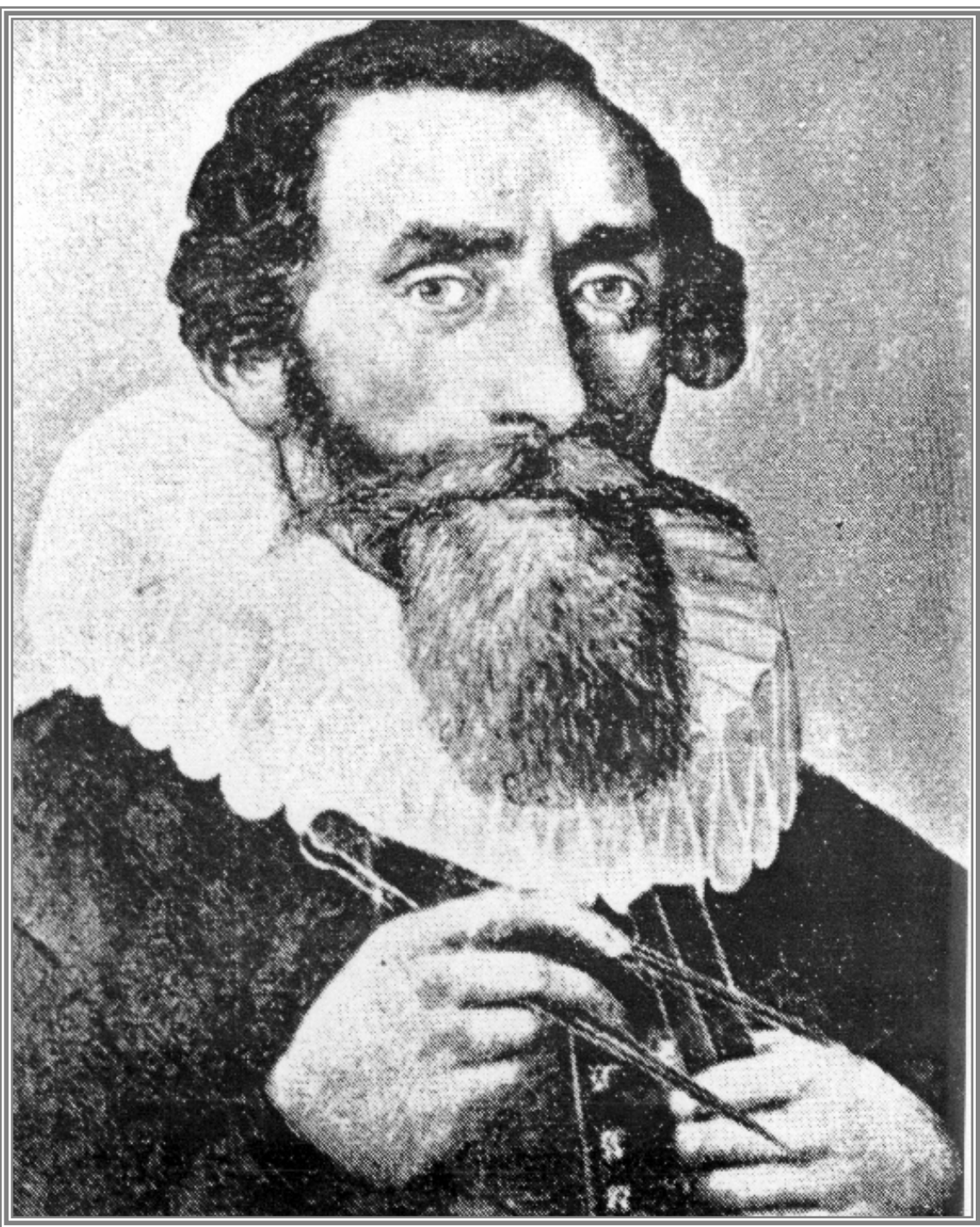
... when something is snatched from him he sits up and growls.

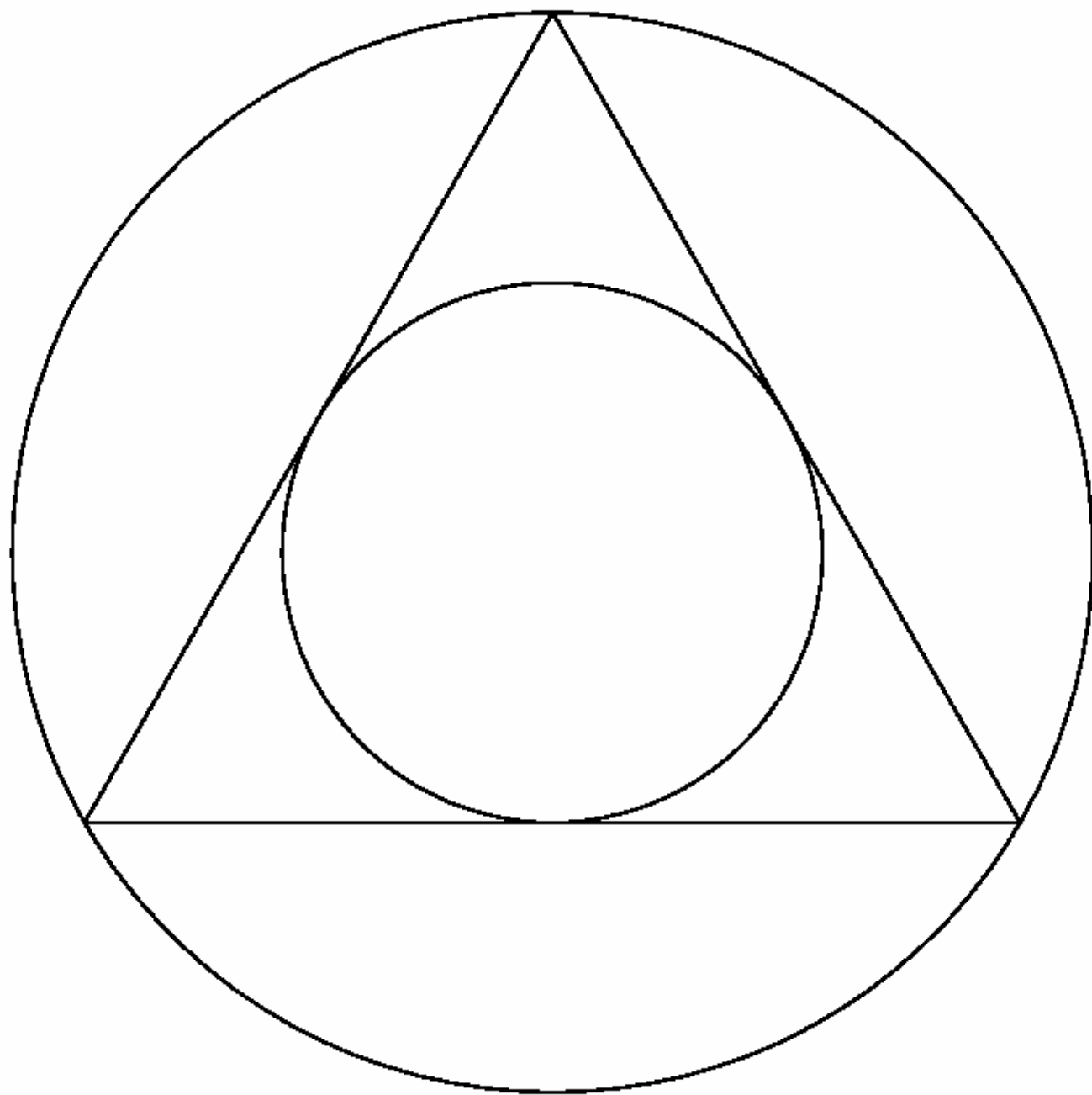
... he barks at wrong doers

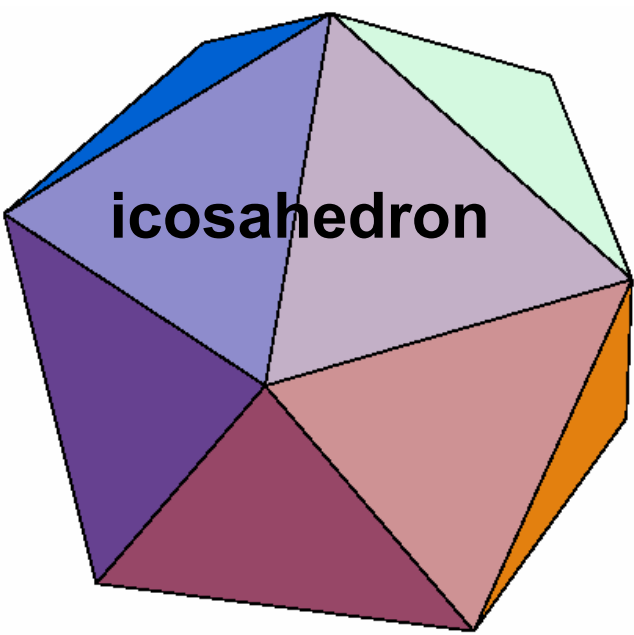
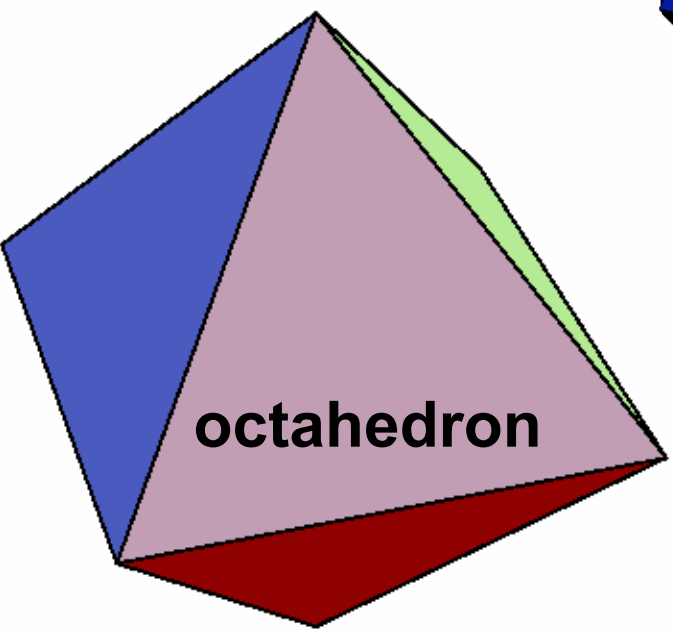
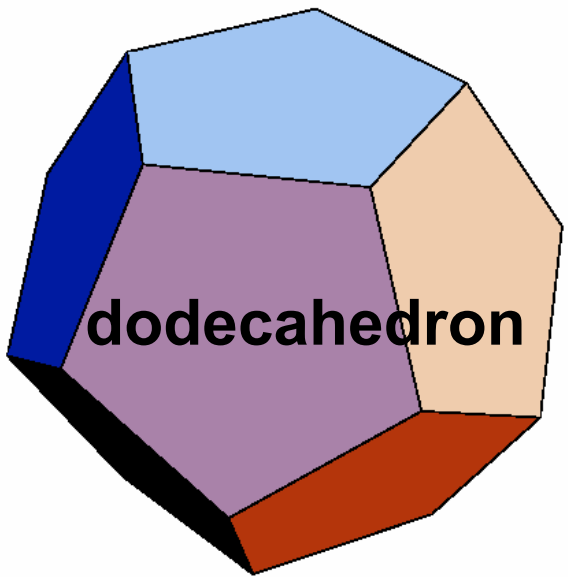
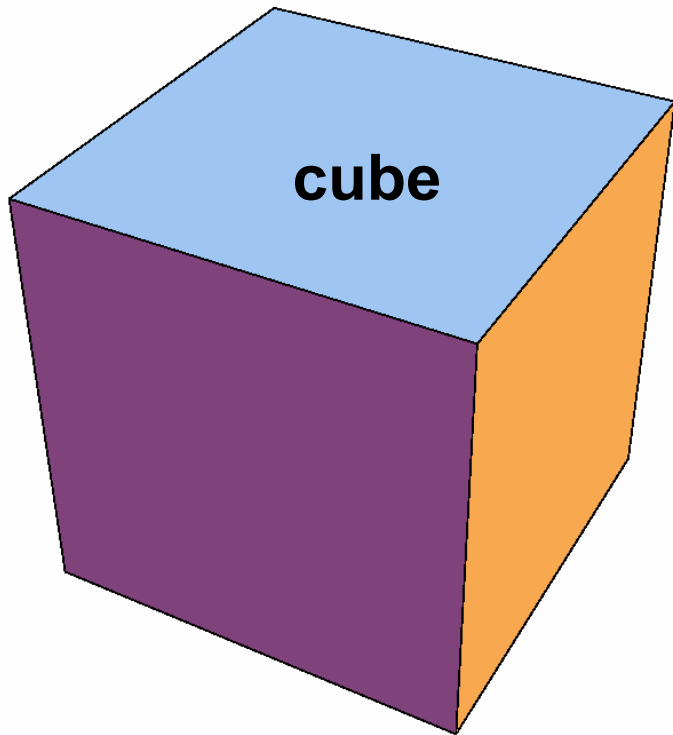
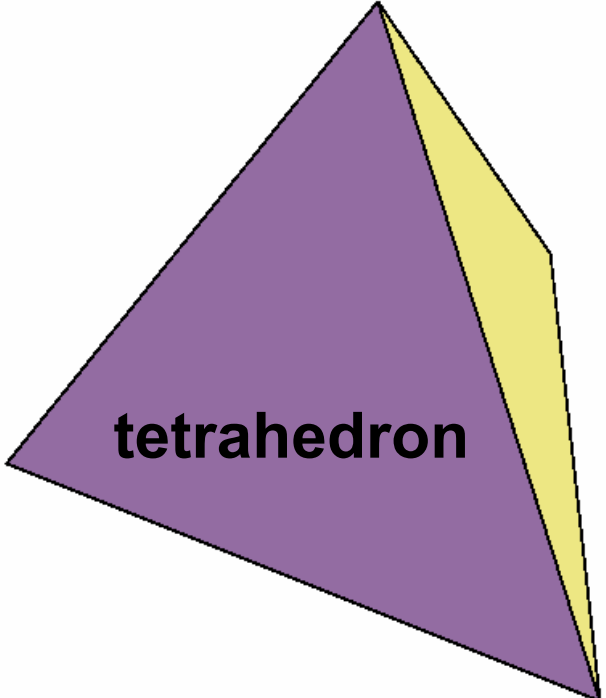
... he is malicious and bites people with sarcasms.

... he has a dog-like horrors of baths

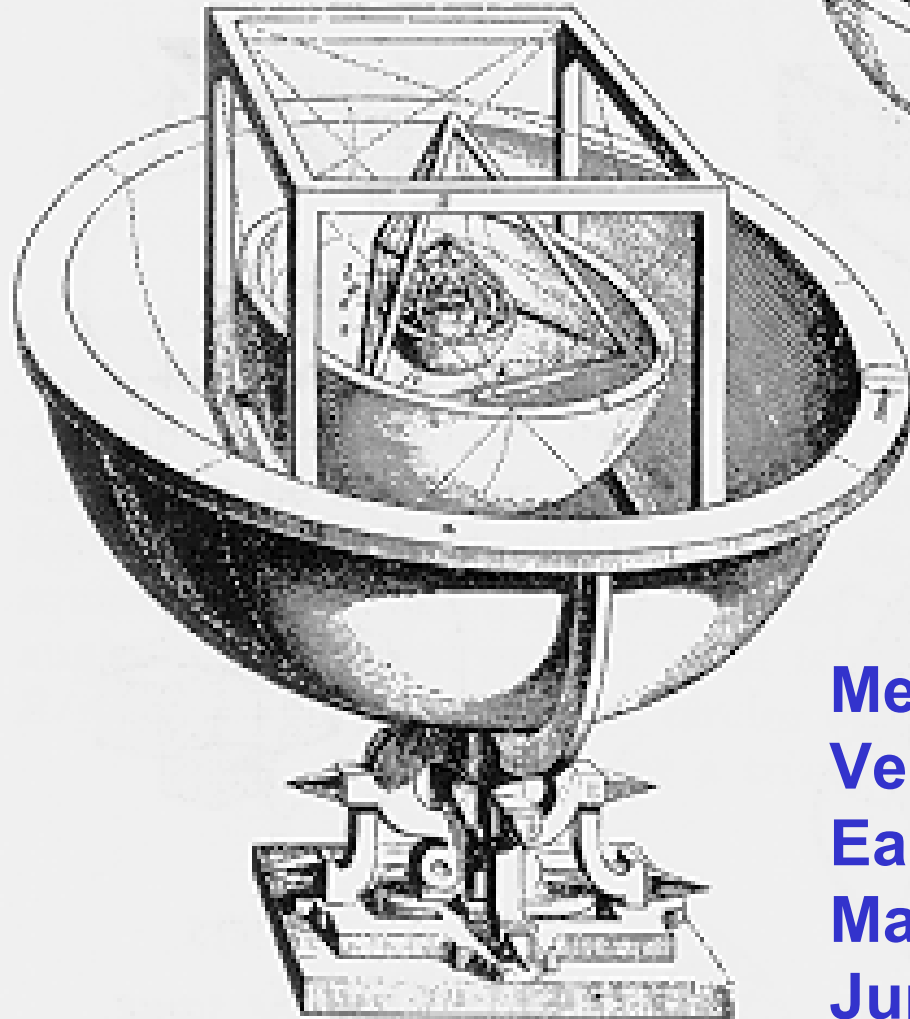








Mysterium Cosmographicum



Mercury – octahedron - Venus
Venus – icosahedron – Earth
Earth – dodecahedron – Mars
Mars – tetrahedron – Jupiter
Jupiter – cube - Saturn

Planets and Polyhedra	from Polyhedra	from Copernicus
Saturn-cube-Jupiter	577	635
Jupiter-tetra-Mars	333	333
Mars-dodeca-Earth	795	795
Earth-icosa-Venus	795	794
Venus-octa-Mercury	707	723

Copernicus, *De Revolutionibus*, Book One, Chapter one:

“First of all, we must note that the universe is spherical. The reason is either that, of all forms, the sphere is the most perfect, ...; or that it is the most capacious* of figures, best suited to enclose and retain all things; ... Hence, no one will question the attribution of this form to the divine bodies.

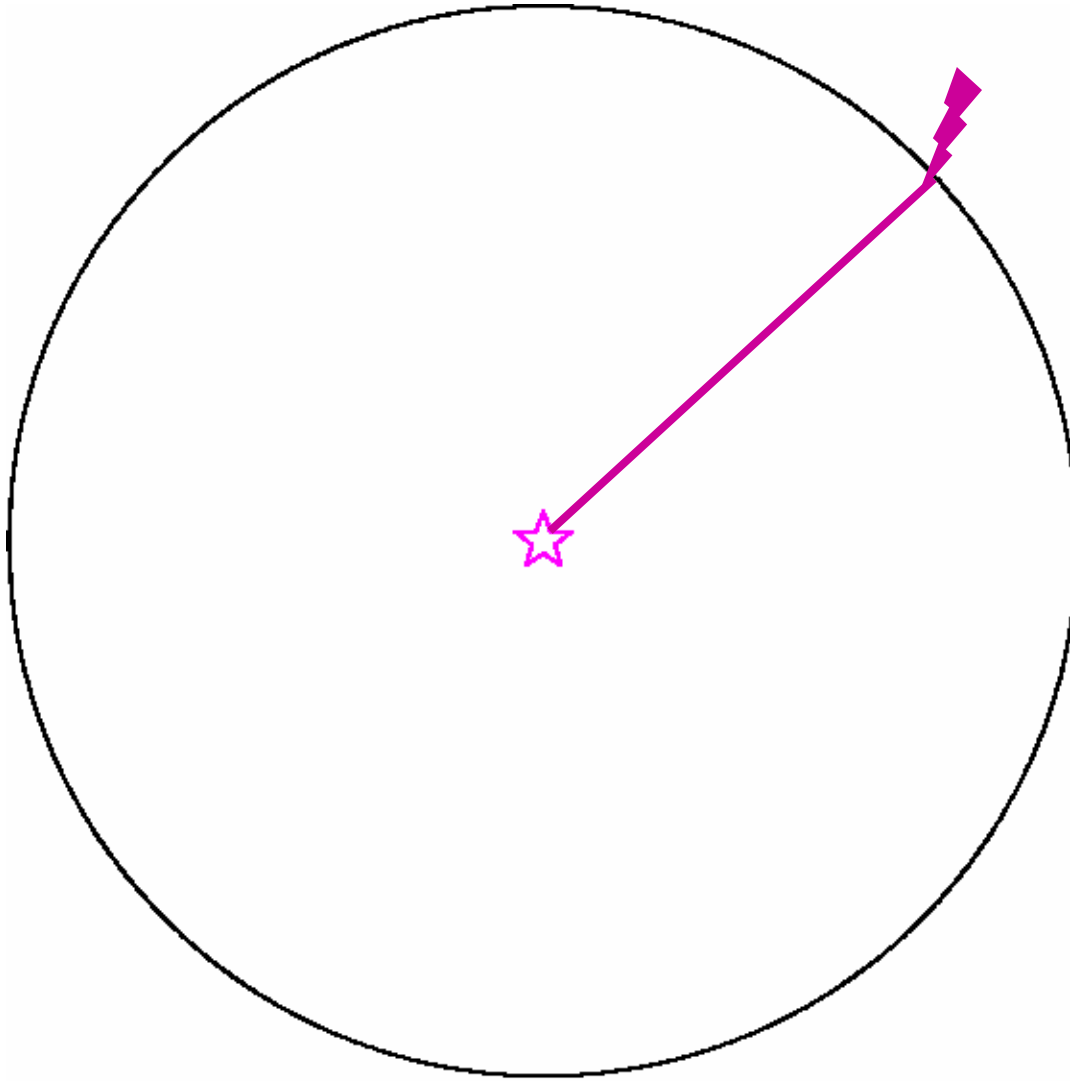
Edward Rosen translation

*capacious: able to contain much.

circle



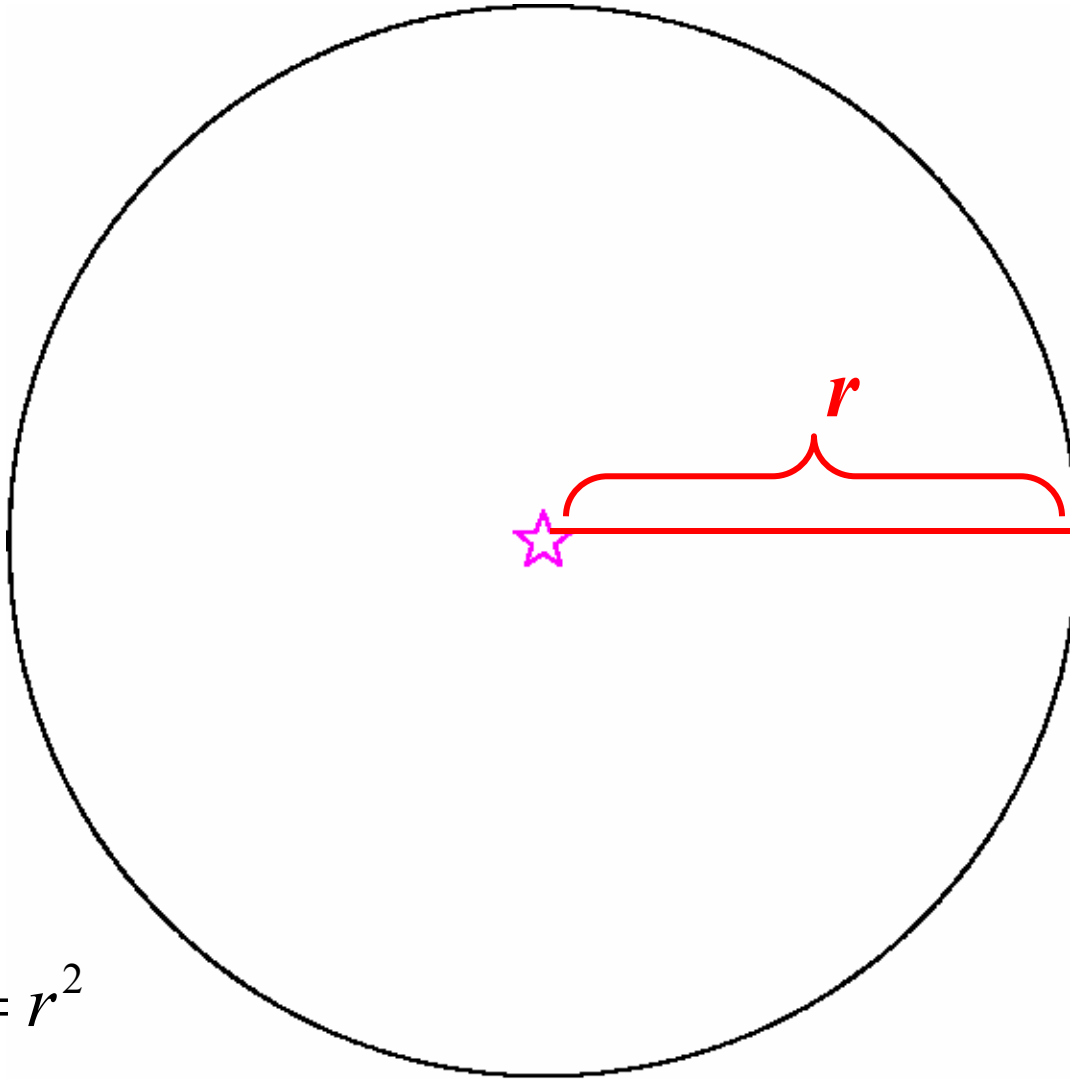
center



circle



center



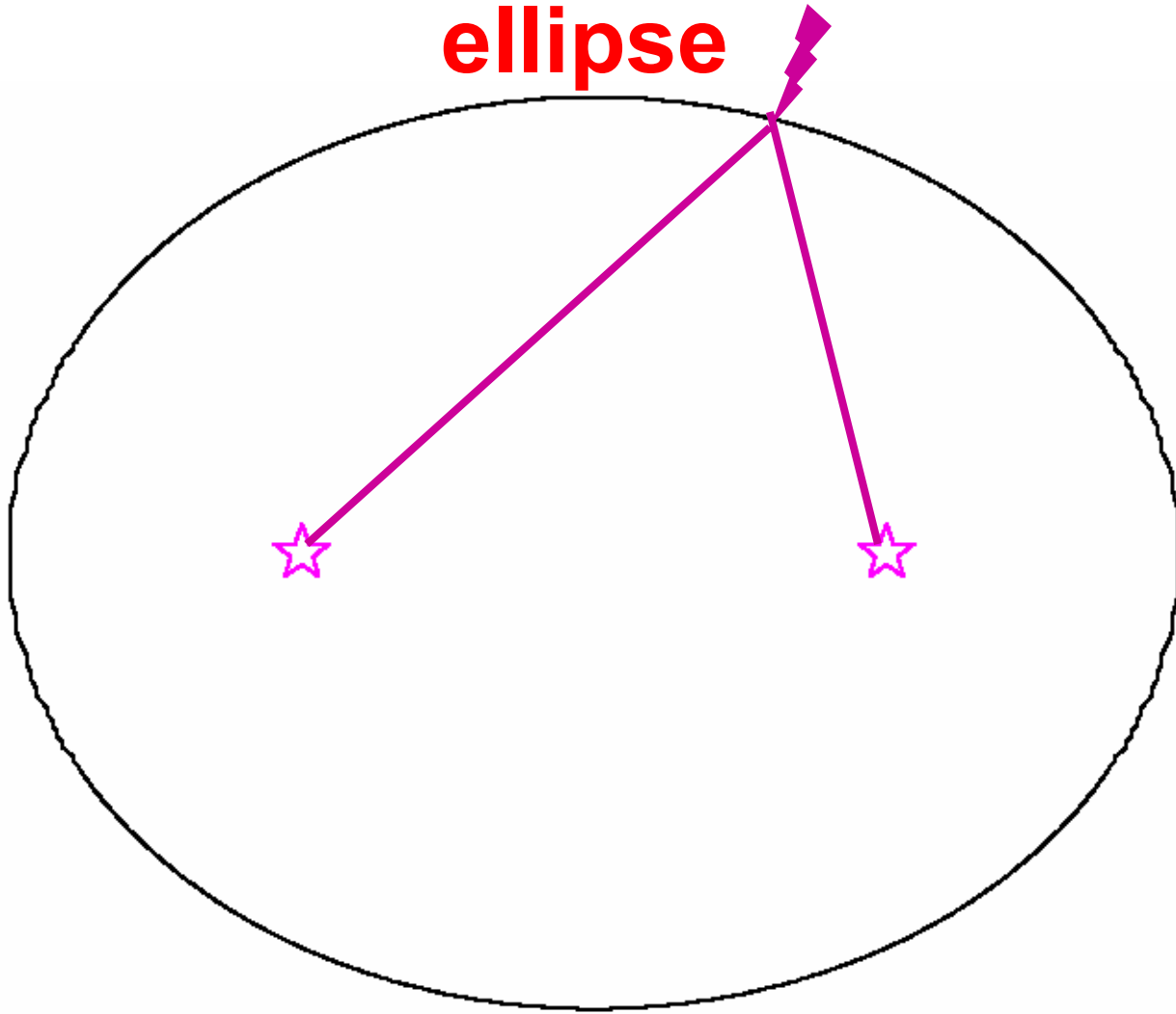
$$x^2 + y^2 = r^2$$

$$\frac{x^2}{r^2} + \frac{y^2}{r^2} = 1 \quad r^2 > 0$$

ellipse

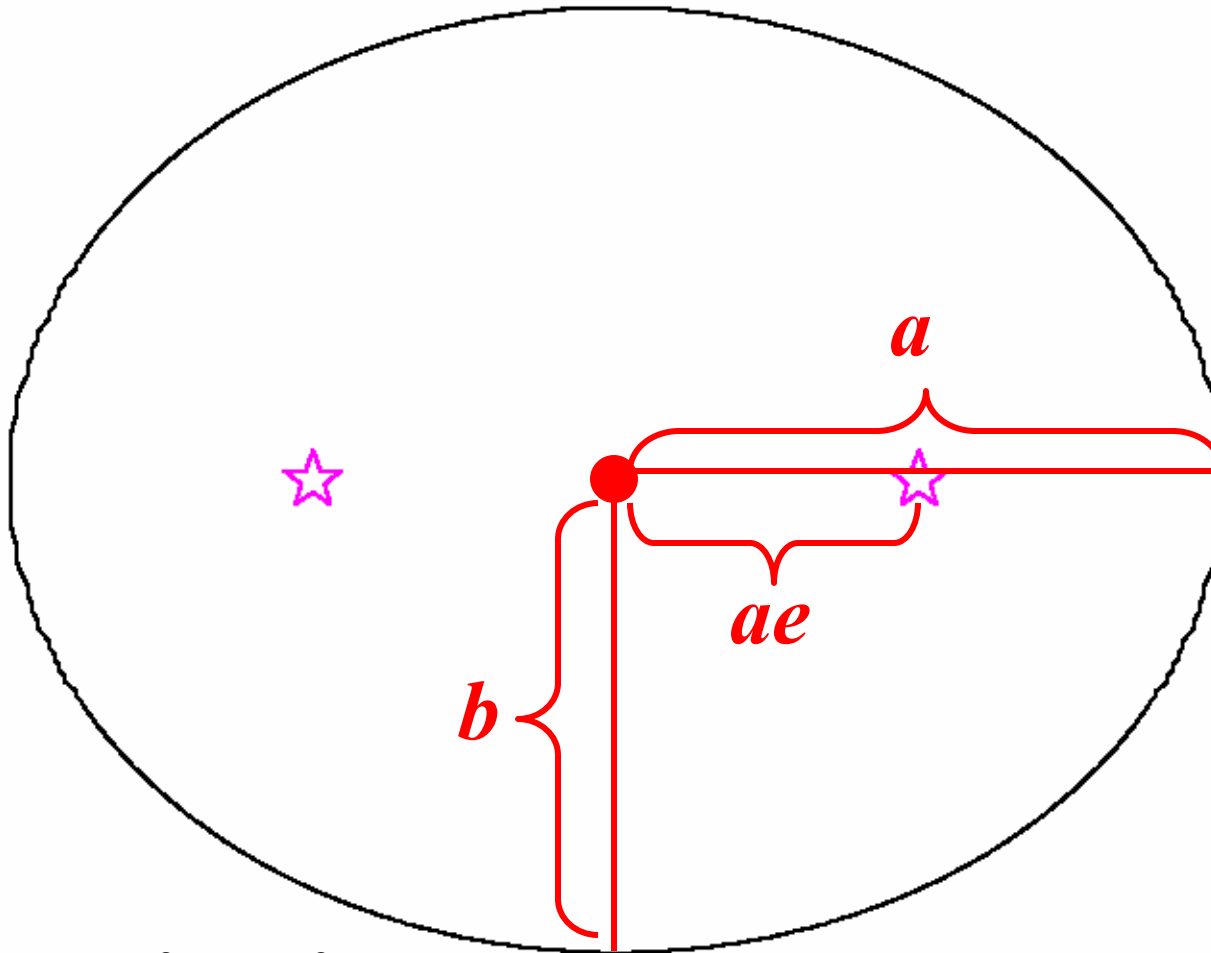


focus



ellipse

☆
focus

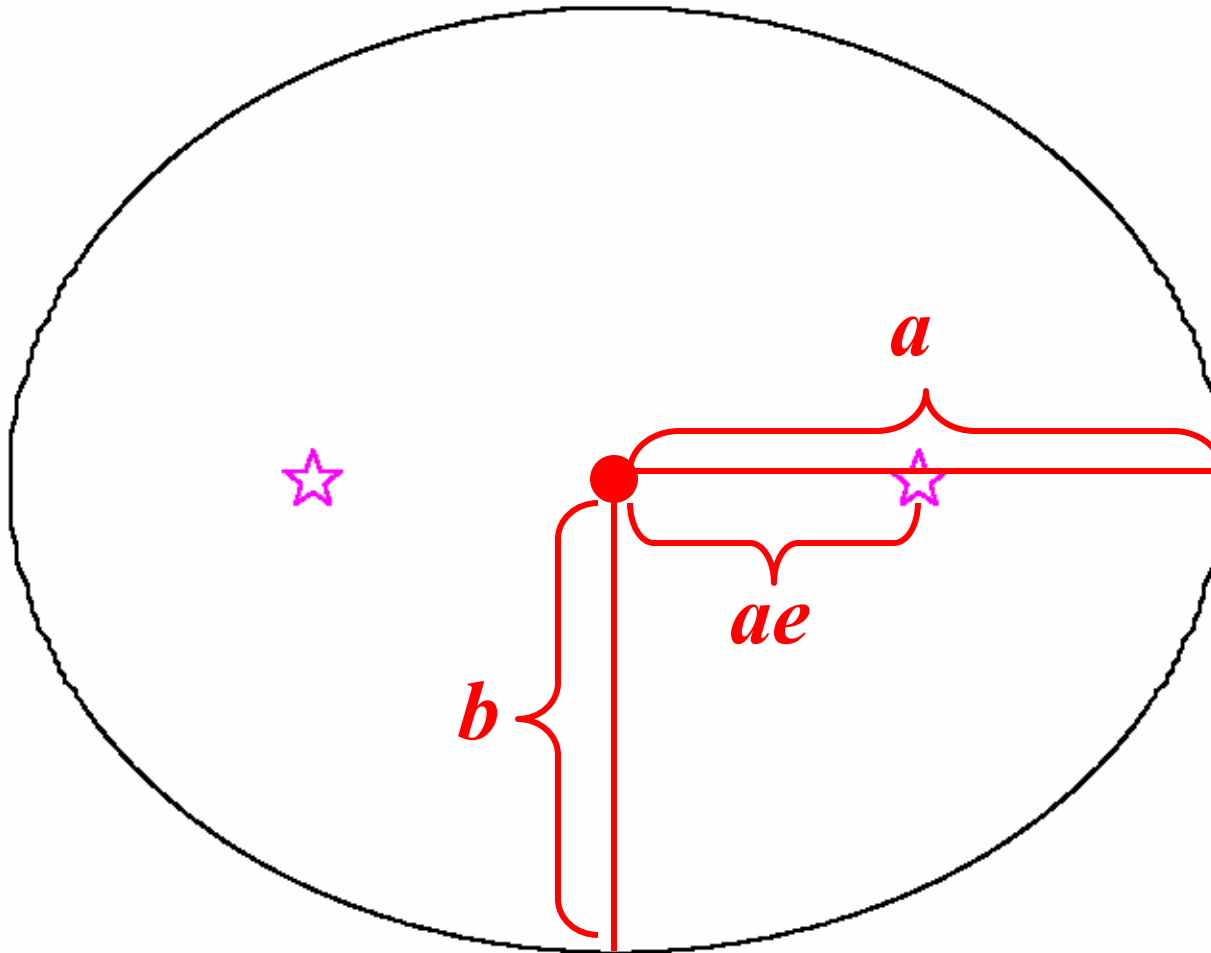


$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad a > b > 0$$

$$\text{eccentricity } e = \sqrt{1 - b^2 / a^2} = 0.5$$

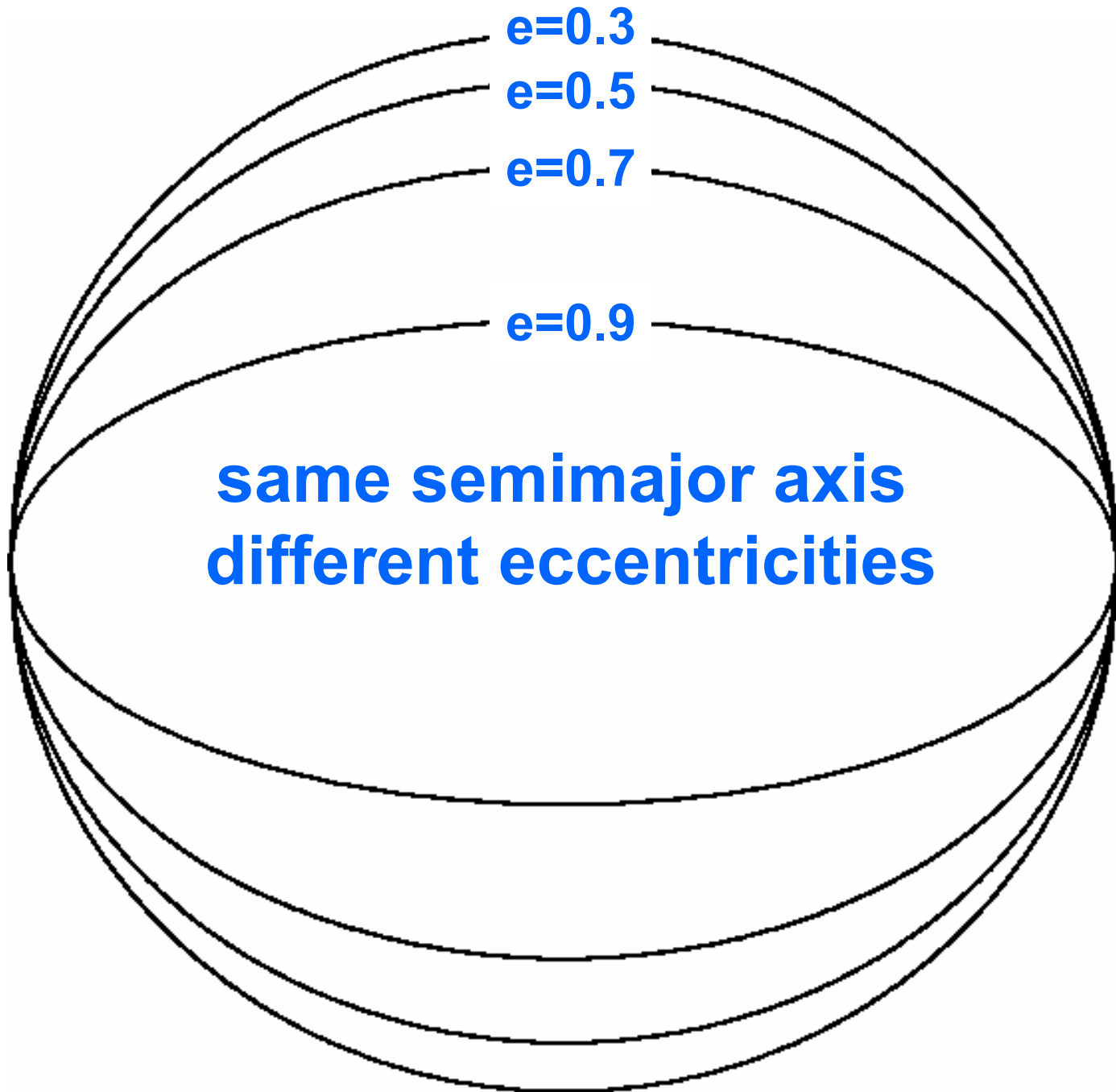
ellipse

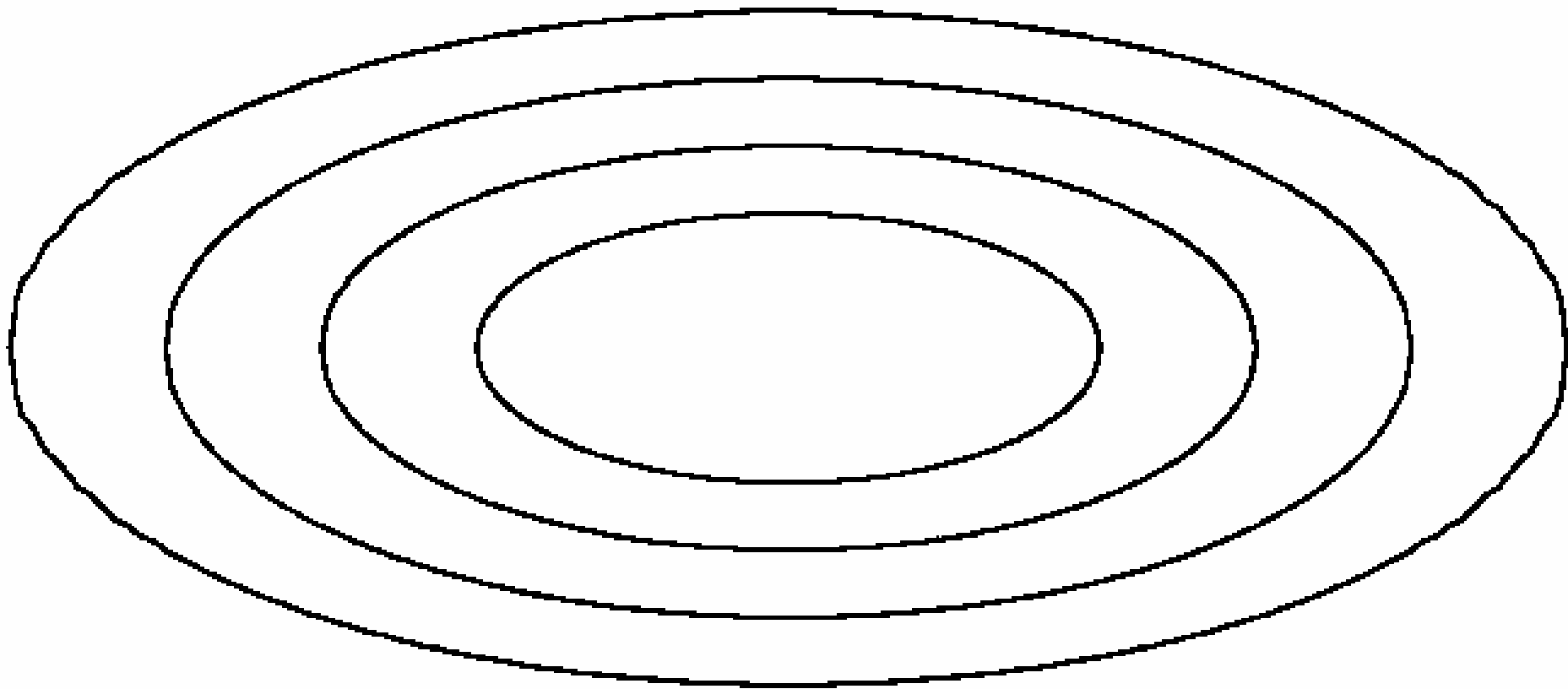
☆
focus



$$\text{eccentricity } e = \sqrt{1 - b^2/a^2} = 0.5$$

$$b/a = \sqrt{1 - e^2} \simeq 1 - \frac{1}{2}e^2 \quad \text{for } e \text{ small}$$

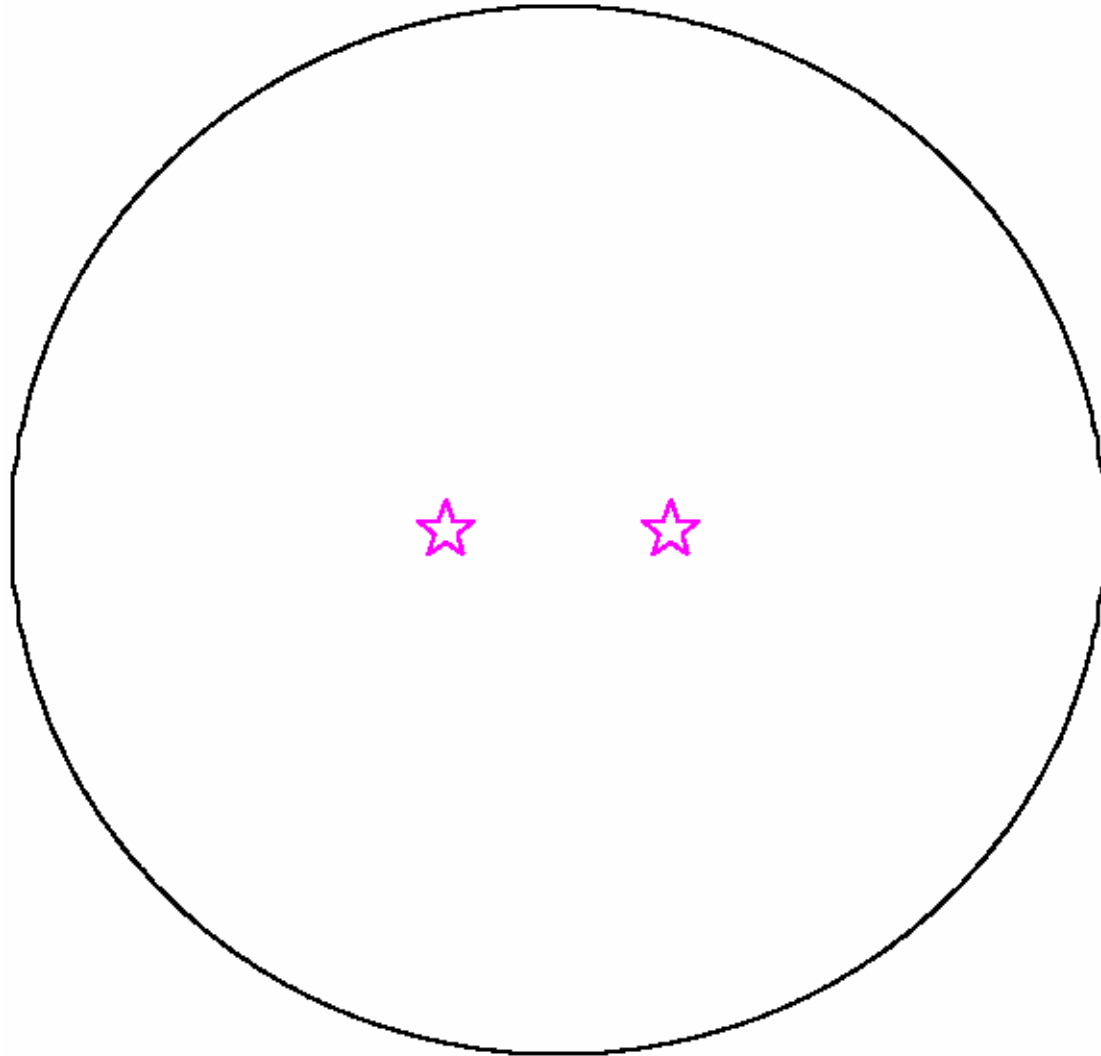




same eccentricity

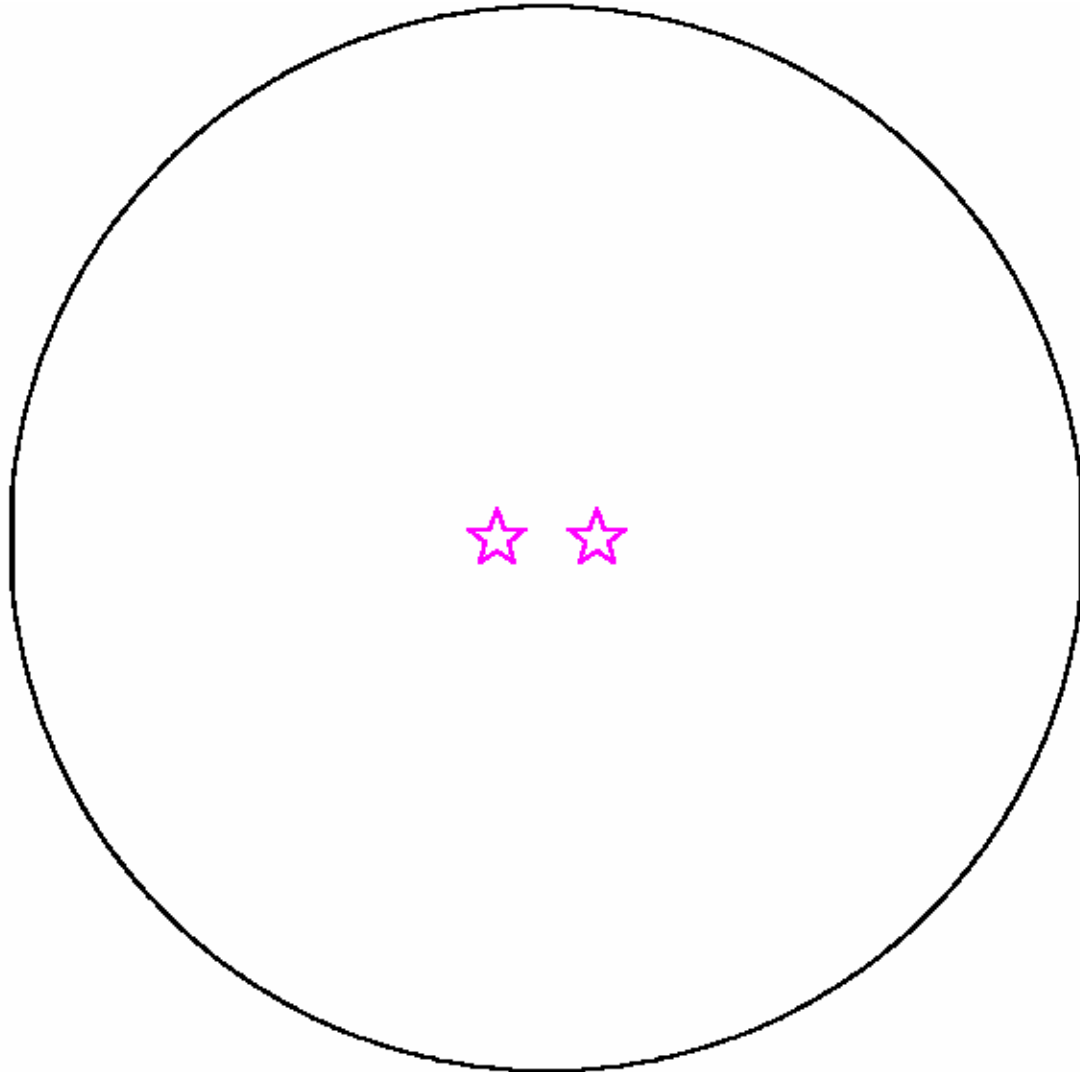
different semimajor axis

Mercury

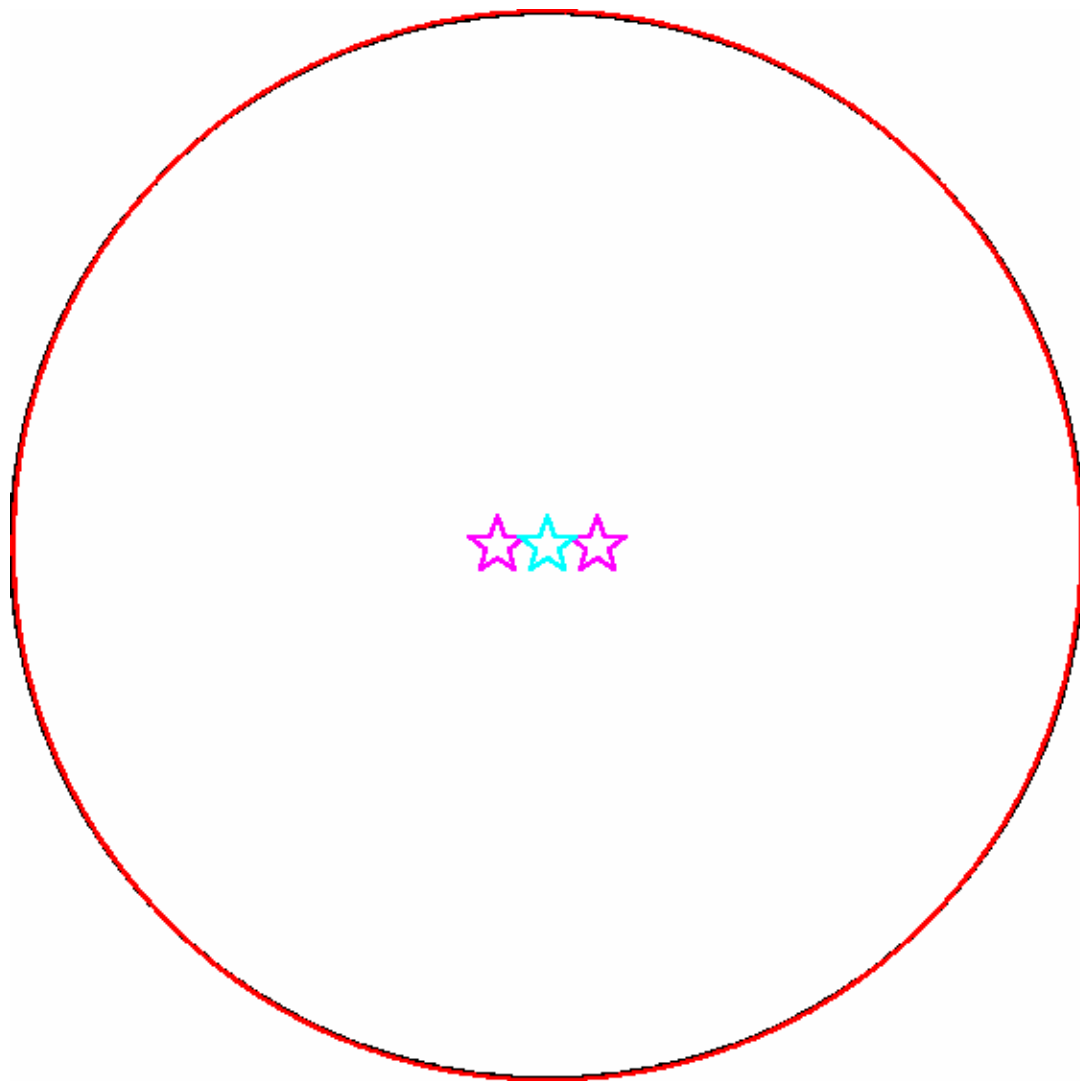


eccentricity = 0.2

Mars

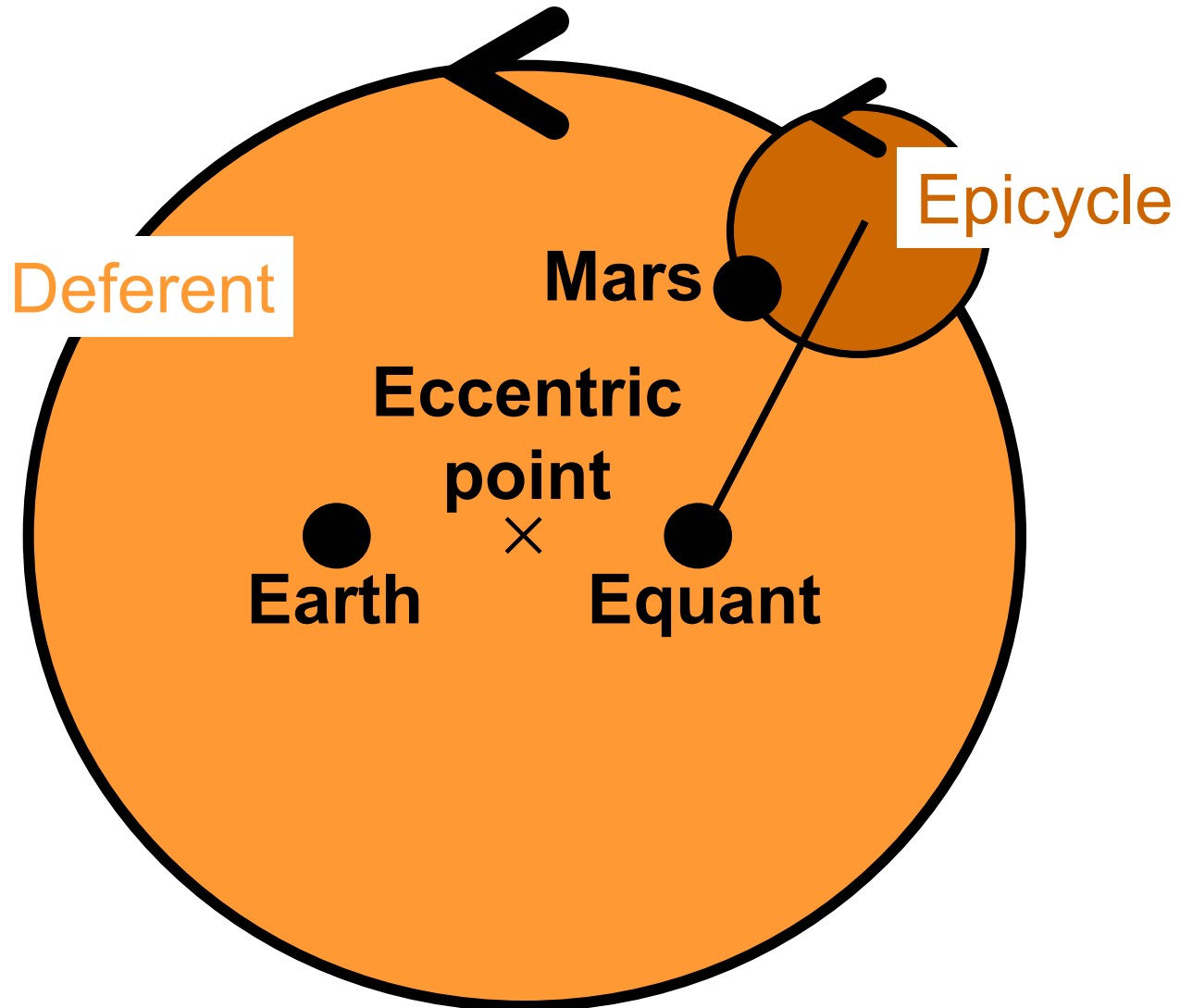


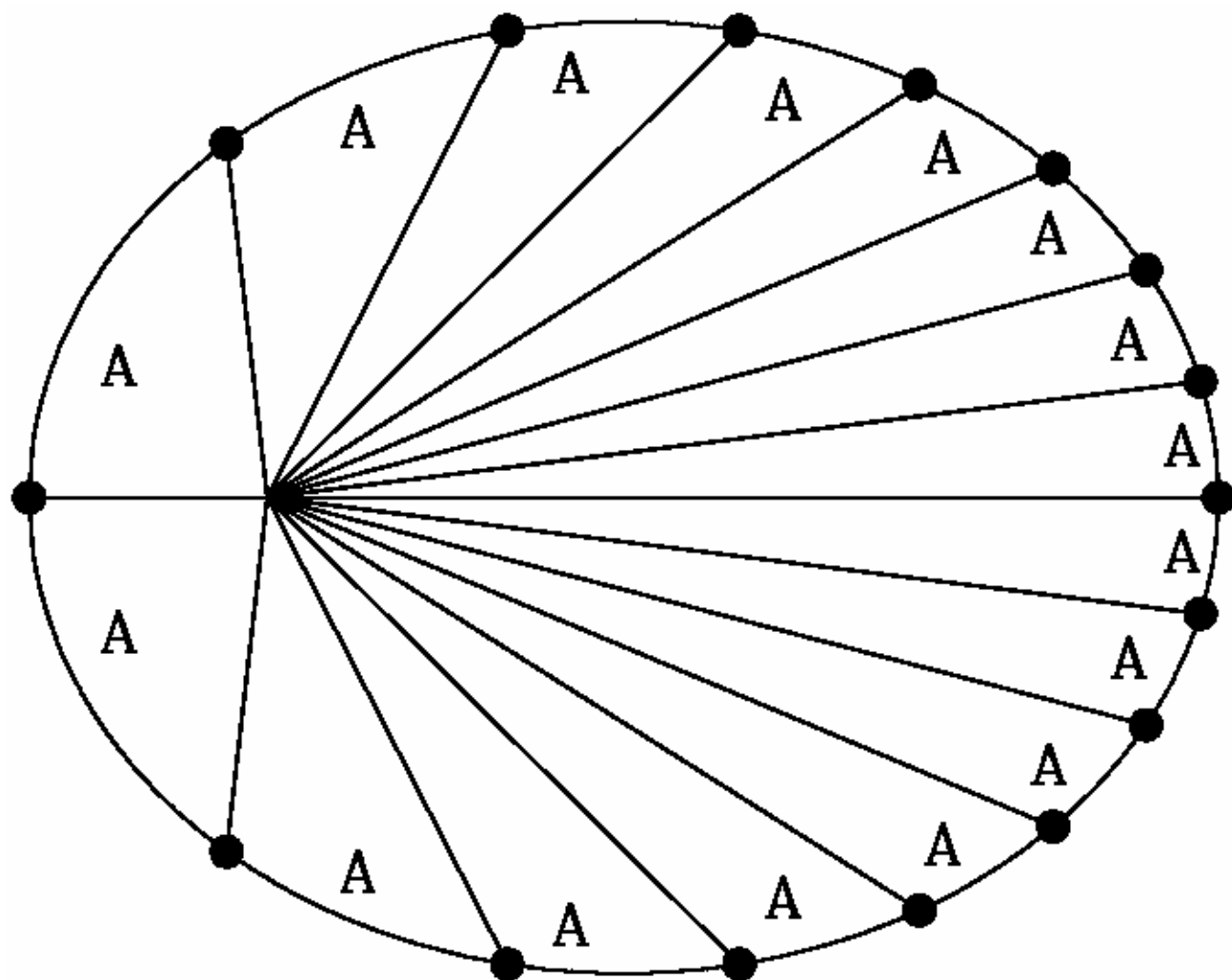
$\text{eccentricity} = 0.09$

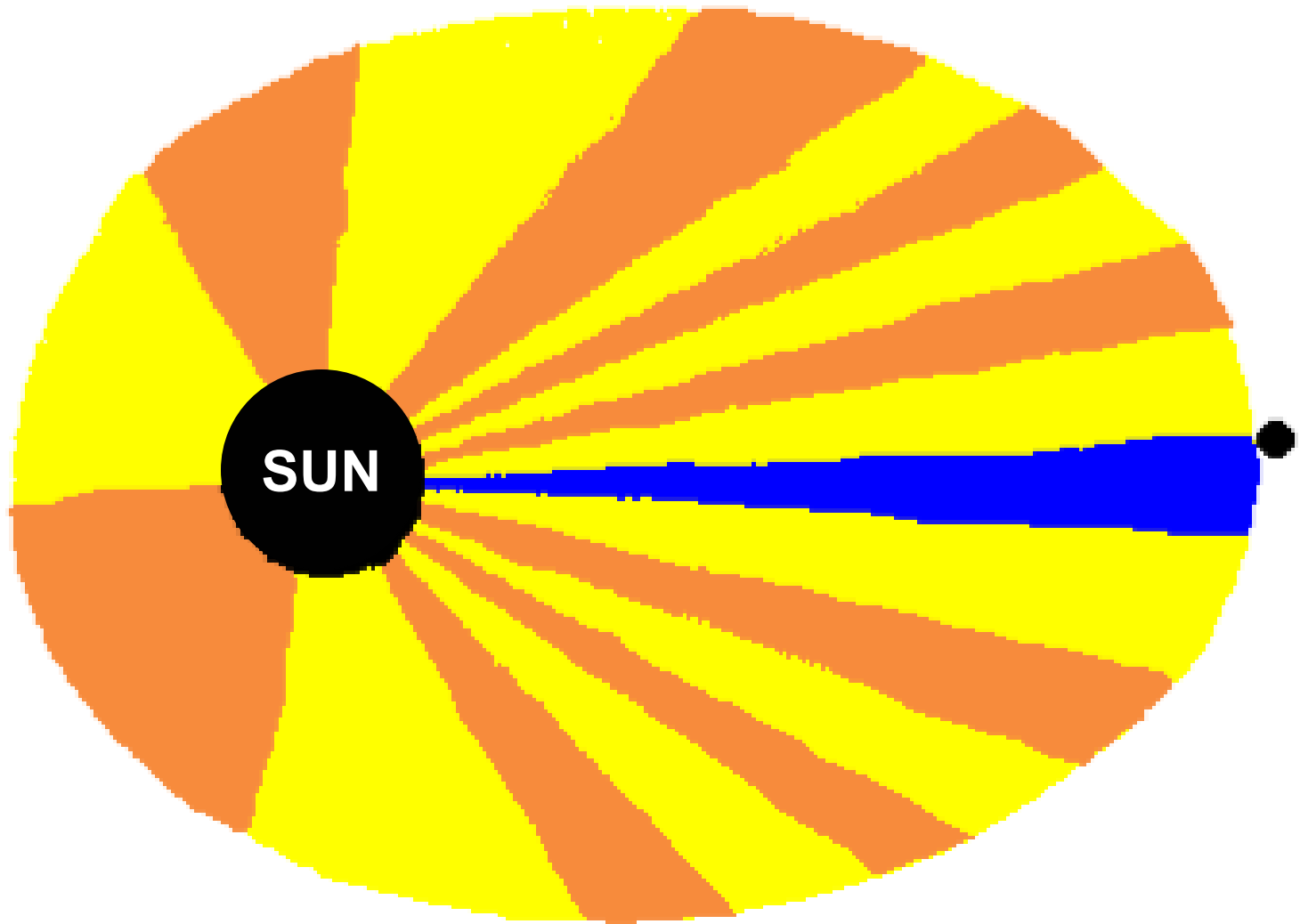


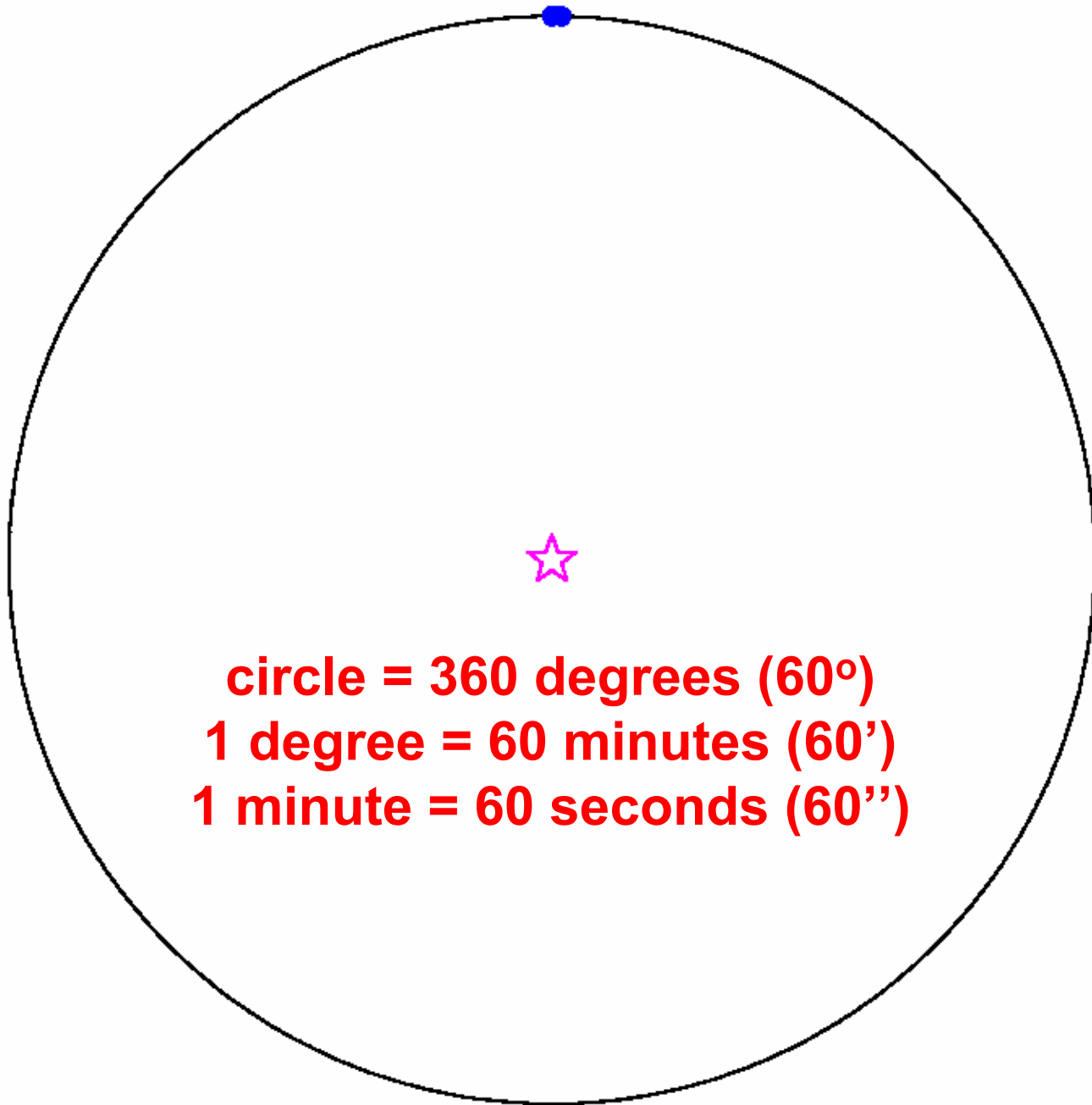
○ **ellipse with eccentricity of Mars** **circle with same area** ○

The Ptolemaic Epicycle

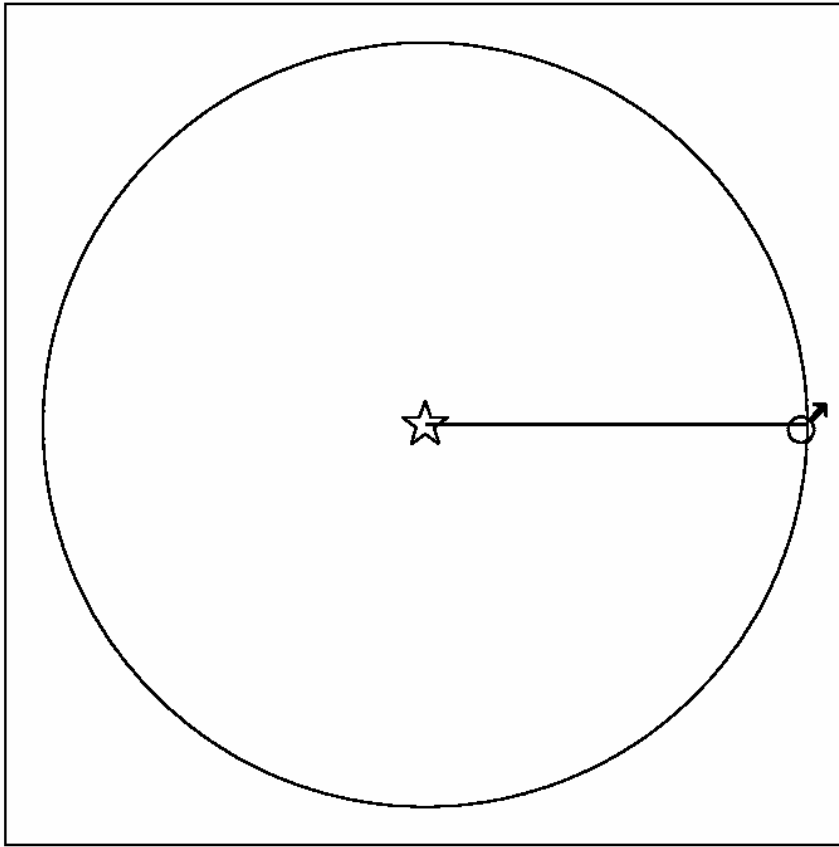




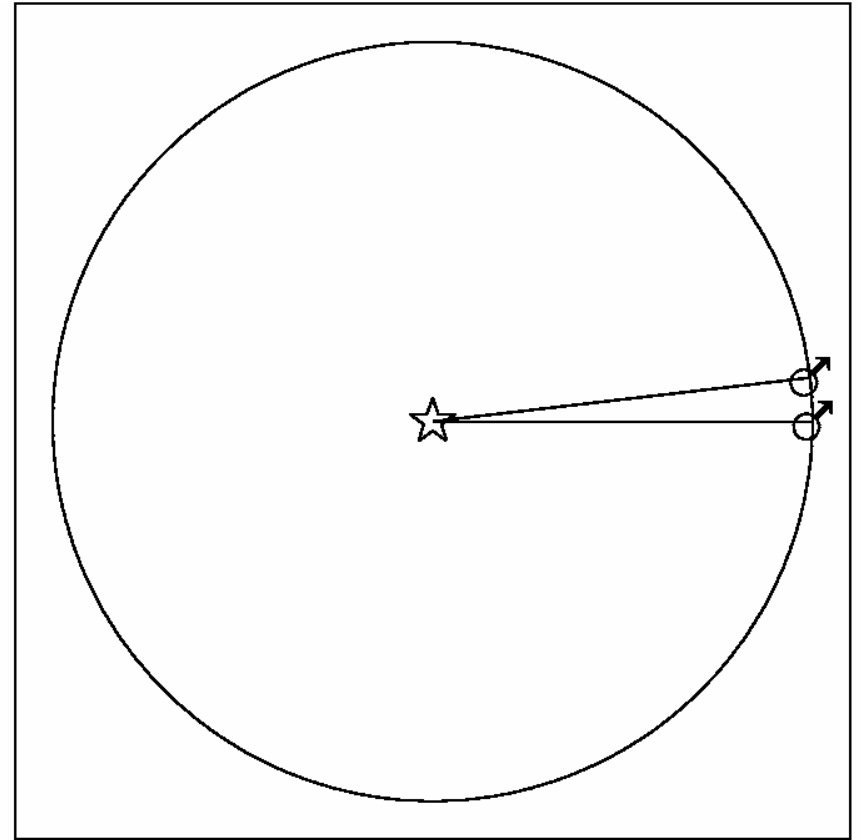




circle = 360 degrees (60°)
1 degree = 60 minutes ($60'$)
1 minute = 60 seconds ($60''$)



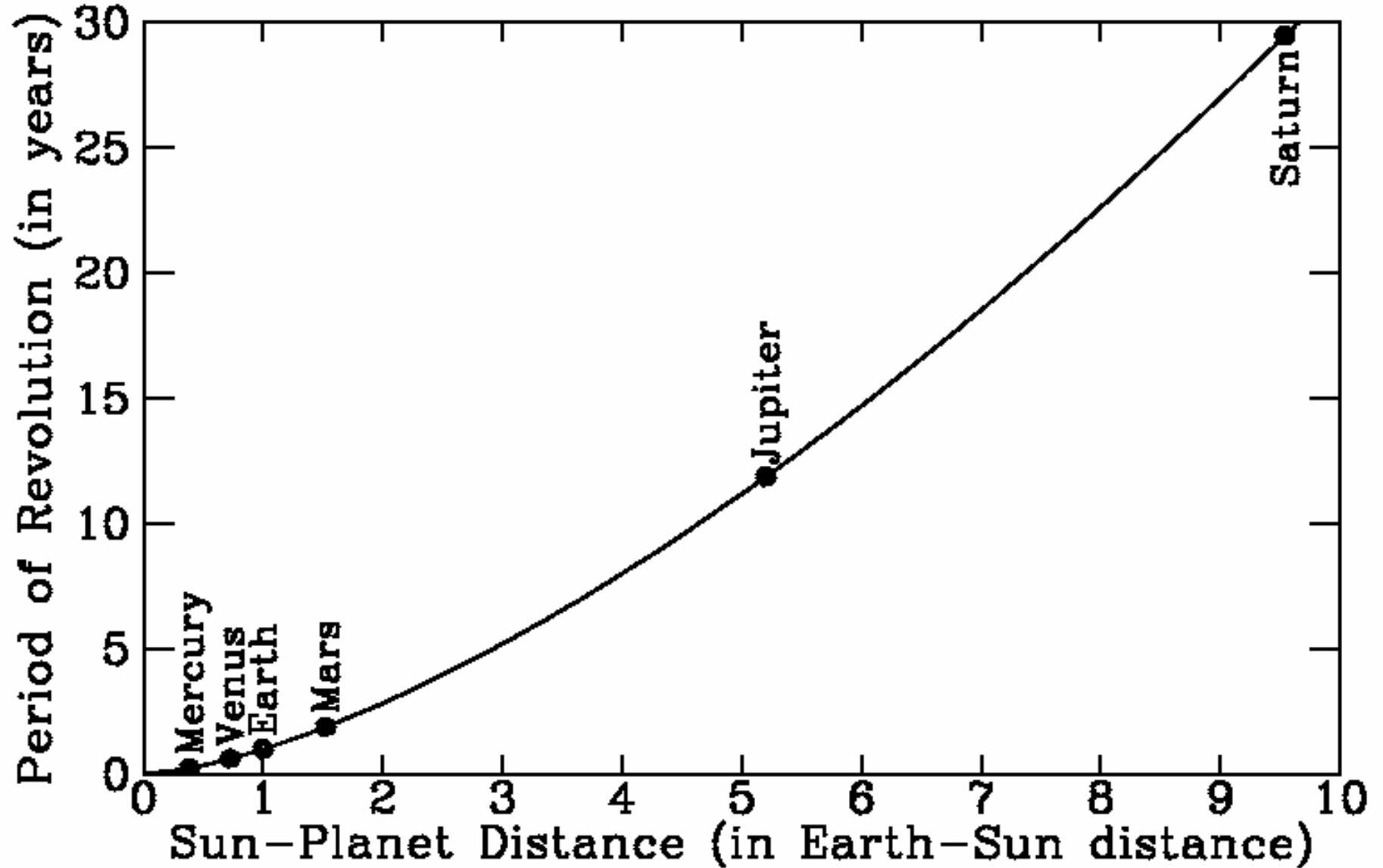
8 minutes of arc

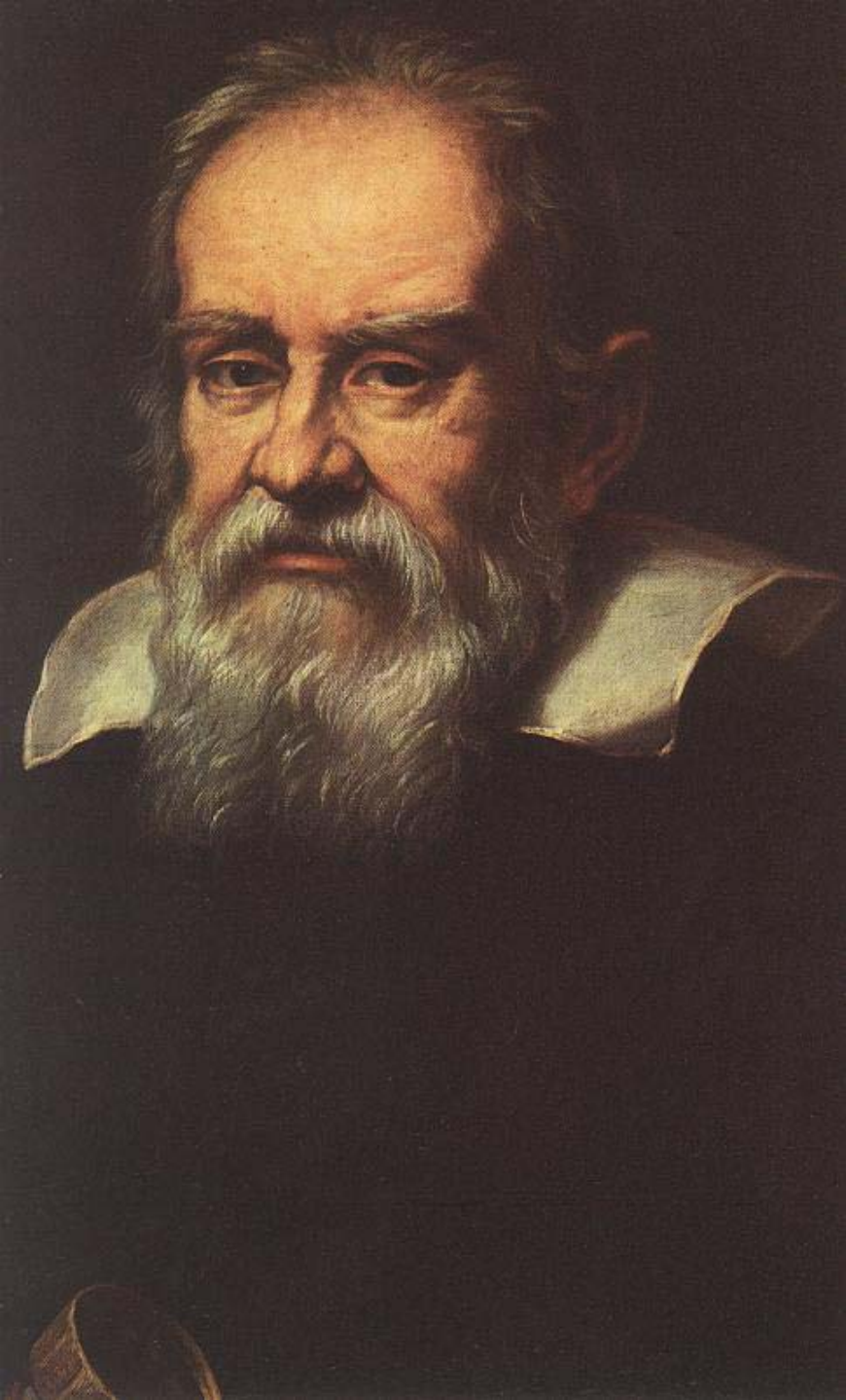


50 X 8 minutes of arc

Planet	period <i>P</i> years	semimajor axis <i>a</i> astronomical units	<i>P</i> ²	<i>a</i> ³
Mercury	0.24	0.06	0.06	0.06
Venus	0.62	0.72	0.4	0.4
Earth	1.0	1.0	1.0	1.0
Mars	1.88	1.52	1.5	1.5
Jupiter	11.9	5.2	140	140
Saturn	29.5	9.5	870	870
Moon	1/12	1/144	1/240	1/14million

Kepler's Third Law: period squared = semimajor axis cubed





Galileo Galilei

1564 – 1642

by

Justus Sustermans

Palazzo Pitti

Firenze

Judith Beheading Holofernes

Caravaggio 1598

Galleria Nazionale d'Arte Antica, Rome





Ecce Homo
Caravaggio
1606
Palazzo Rosso,
Genoa



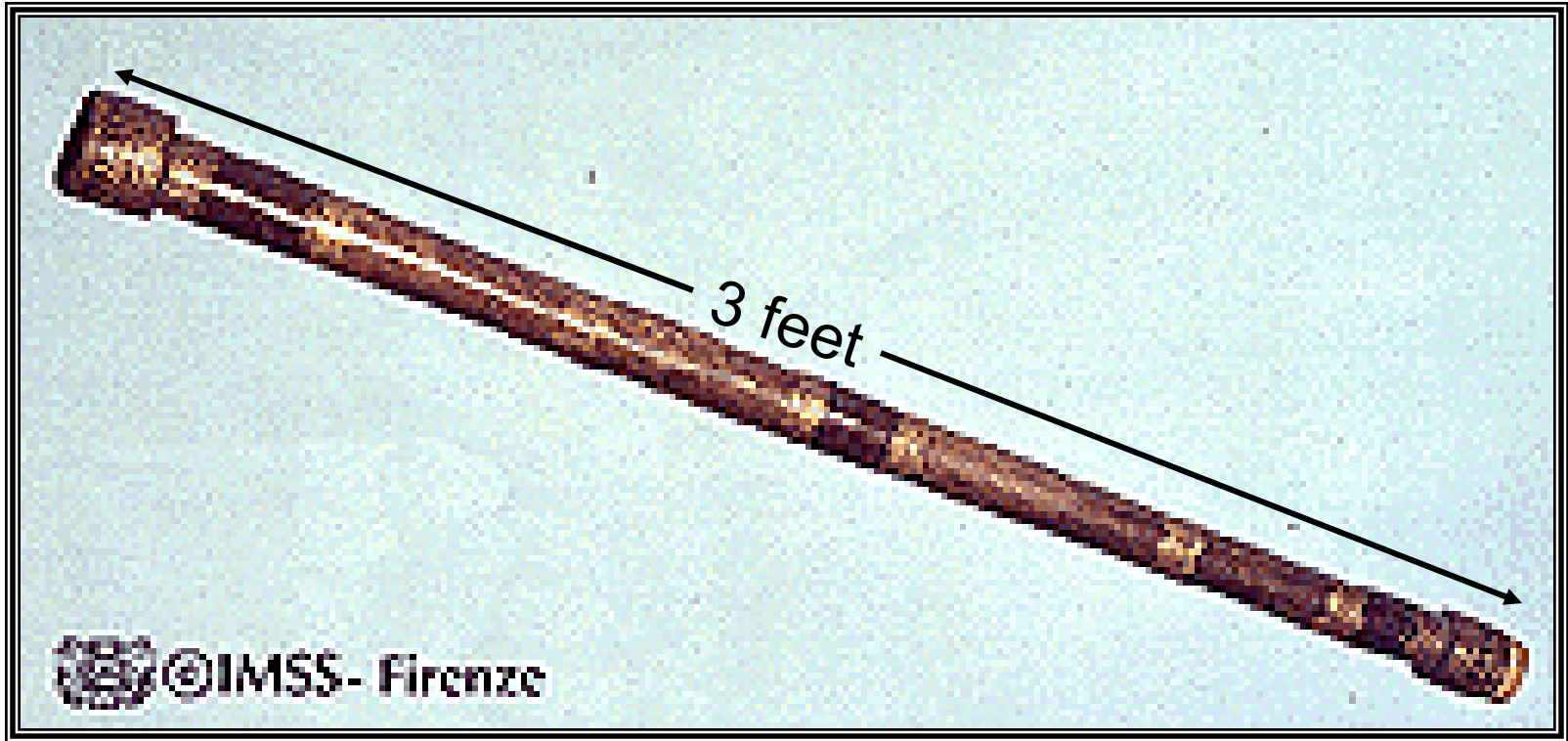
**Maffeo Barberini
(1568 - 1644)**

**Urban VIII
(1623 - 1644)**

**Caravaggio 1599
Private Collection, Firenze**



Caravaggio
The Sacrifice of Isaac
1601-02
Galleria degli Uffizi, Florence



Museo di Storia della Scienza, Firenze

**Wooden tube covered with red leather decorated in gold
21 X magnification
16mm objective lens**



Museo di Storia della Scienza



The Power of 3!

- 1. Spots on the Sun**
- 2. Mountains on the moon**
- 3. Phases of Venus**
- 4. Rings of Saturn**
- 5. Stars are distant**
- 6. Stars invisible to the naked eye**
- 7. Milky way made of stars**
- 8. Moons of Jupiter**